

What is claimed is:

- 1 1. A method for blocking the permeability of an elevated-temperature zone
2 in a reservoir of a subterranean formation penetrated by a wellbore, the
3 method comprising the steps of:
4 a. selecting the zone to be treated, wherein the upper limit of the
5 temperature range of the zone is equal to or greater than 190°F (88°C);
6 b. forming a well treatment fluid comprising:
7 i. water;
8 ii. a water-soluble polymer comprising polymerized vinyl
9 amine units;
10 iii. an organic compound capable of crosslinking with the vinyl
11 amine units of the water-soluble polymer;
12 c. selecting the water-soluble polymer and the organic compound of the
13 well treatment fluid such that the gel time of the well treatment fluid is
14 at least 2 hours when measured at the upper limit of the temperature
15 range of the zone; and
16 d. injecting the well treatment fluid through the wellbore and into the
17 zone.
- 1 2. The method according to Claim 1, wherein the upper limit of the
2 temperature range of the zone is equal to or greater than 250°F (121°C).
- 1 3. The method according to Claim 1 or 2 , wherein the upper limit of the
2 temperature range of the zone is equal to or less than 350°F (177°C).
- 1 4. The method according to Claim 3, wherein the lower limit of the
2 temperature range of the zone is equal to or greater than 190°F (88°C).
- 1 5. The method according to Claim 1, wherein the lower limit of the
2 temperature range of the zone is equal to or greater than 190°F (88°C).

- 1 6. The method according to Claim 1, wherein the water is selected from the
2 group consisting of fresh water, seawater, natural brine, formulated brine,
3 2% KCl solution, and any combination in any proportion of the foregoing.

- 1 7. The method according to Claim 1, wherein the water-soluble polymer
2 further comprises polymerized vinyl alcohol units.

- 1 8. The method according to Claim 7, wherein the water-soluble polymer
2 comprises a copolymer of vinyl amine units and vinyl alcohol units.

- 1 9. The method according to Claim 1 or 8, wherein the water-soluble polymer
2 comprises up to 50 mole % polymerized vinyl amine units.

- 1 10. The method according to Claim 1 or 8, wherein the mole % of the
2 polymerized vinyl amine units of the water-soluble polymer is selected to
3 at least partially control the gel time of the well treatment fluid when
4 measured at the upper limit of the temperature range of the zone.

- 1 11. The method according to Claim 1, wherein the organic compound
2 comprises an acrylamide-based polymer.

- 1 12. The method according to any one of Claim 11, wherein the ratio of the
2 water-soluble polymer to the acrylamide-based polymer is from about
3 50:1 to about 1:1.

1 13. The method according to Claim 1, wherein the organic compound is
2 selected from the group consisting of polyacrylamide; acrylamide/t-butyl
3 acrylate copolymer; alkyl acrylate polymer; 2-acrylamido-2-
4 methylpropane sulfonic acid/acrylamide copolymers; sulfonated
5 styrene/maleic anhydride copolymers; vinylpyrrolidone/2-acrylamido-2-
6 methylpropane sulfonic acid/acrylamide terpolymers; 2-acrylamido-2-
7 methylpropane sulfonic acid/N-N-dimethylacrylamide/acrylamide
8 terpolymers; sulfonated styrene/maleic anhydride copolymer; a vinyl
9 pyrrolidone/2-acrylamido-2-methylpropane sulfonic acid/acrylamide
10 terpolymer; an 2-acrylamido-2-methylpropane sulfonic acid/N-N-
11 dimethylacrylamide/acrylamide terpolymer; and any combination in any
12 proportion of the foregoing.

1 14. The method according to Claim 13, wherein the alkyl acrylate polymer
2 comprises a polymer containing at least one unit selected from the group
3 consisting of dimethylaminoethyl methacrylate, dimethylaminopropyl
4 methacrylamide, quaternized dimethylaminoethyl methacrylate, and any
5 combination in any proportion of the foregoing.

1 15. The method according to Claim 1, wherein the organic compound is
2 selected from the group consisting of any one or more polymers
3 comprising: polymerized units having a cross-linking functionality
4 capable of crosslinking with the vinyl amine units of the water-soluble
5 polymer.

1 16. The method according to Claim 1 or 15, wherein the organic compound is
2 selected to have the cross-linking functionality sterically hindered.

- 1 17. The method according to Claim 16, wherein the organic compound is
2 further selected from the group consisting of any one or more polymers
3 comprising: polymerized units of t-butyl acrylate and 2-acrylamido-2-
4 methylpropanesulfonic acid, and any combination in any proportion of the
5 foregoing.

- 1 18. The method according to Claim 1, wherein the organic compound is
2 further selected from the group consisting of any one or more polymers
3 comprising: polymerized units of t-butyl acrylate and 2-acrylamido-2-
4 methylpropanesulfonic acid, and any combination in any proportion of the
5 foregoing.

- 1 19. The method according to Claim 1, wherein the organic compound is
2 further selected from the group consisting of: sulfonated styrene/maleic
3 anhydride copolymer, a vinyl pyrrolidone/2-acrylamido-2-
4 methylpropanesulfonic acid copolymer/acrylamide terpolymer, an 2-
5 acrylamido-2-methylpropanesulfonic acid copolymer/N-N-
6 dimethylacrylamide/acrylamide terpolymer, and any combination in any
7 proportion of the foregoing.

- 1 20. The method according to Claim 1, wherein the gel time of the well
2 treatment fluid is less than 100 hours when measured at the upper limit of
3 the temperature range of the zone.

- 1 21. The method according to Claim 1, wherein the gel time is less than 30
2 hours when measured at the upper limit of the temperature range of the
3 zone.

1 22. The method according to Claim 1, further comprising the step of: delaying
2 any substantial flowback from the zone for at least the gel time of the well
3 treatment fluid after the step of injecting the well treatment fluid into the
4 zone.

1 23. The method according to Claim 1, further comprising the step of: injecting
2 a breaker into the zone, the breaker adapted to break a gel formed by the
3 well treatment fluid.

1 24. A well treatment fluid for blocking the permeability of an elevated-
2 temperature zone in a reservoir of a subterranean formation penetrated by
3 a wellbore, the well treatment fluid comprising:
4 i. water;
5 ii. a water-soluble polymer comprising polymerized vinyl
6 amine units;
7 iii. an organic compound capable of crosslinking with the vinyl
8 amine units of the water-soluble polymer;
9 wherein the water-soluble polymer and the organic compound of the well
10 treatment fluid are selected such that the gel time of the well treatment
11 fluid is at least 2 hours when measured at 190°F (88°C).

1 25. The well treatment fluid according to Claim 24, wherein the gel time of
2 the well treatment fluid is at least 2 hours when measured at 250°F
3 (121°C).

1 26. The well treatment fluid according to Claim 24, wherein the gel time of
2 the well treatment fluid is at least 2 hours when measured at 350°F
3 (177°C).

- 1 27. The well treatment fluid according to Claim 24, wherein the water is
2 selected from the group consisting of fresh water, seawater, natural brine,
3 formulated brine, 2% KCl solution, and any combination in any proportion
4 of the foregoing.

- 1 28. The well treatment fluid according to Claim 24, wherein the water-soluble
2 polymer further comprises polymerized vinyl alcohol units.

- 1 29. The well treatment fluid according to Claim 28, wherein the water-soluble
2 polymer comprises a copolymer of vinyl amine units and vinyl alcohol
3 units.

- 1 30. The well treatment fluid according to Claim 24 or 29, wherein the water-
2 soluble polymer comprises up to 50 mole % polymerized vinyl amine
3 units.

- 1 31. The well treatment fluid according to Claim 24 or 29, wherein the mole %
2 of the polymerized vinyl amine units of the water-soluble polymer is
3 selected to at least partially control the gel time of the well treatment fluid
4 when measured at the upper limit of the temperature range of the zone.

- 1 32. The well treatment fluid according to Claim 24, wherein the organic
2 compound comprises an acrylamide-based polymer.

- 1 33. The well treatment fluid according to Claim 32, wherein the ratio of the
2 water-soluble polymer to the acrylamide-based polymer is from about
3 50:1 to about 1:1.

1 34. The well treatment fluid according to Claim 24, wherein the organic
2 compound is selected from the group consisting of polyacrylamide;
3 acrylamide/t-butyl acrylate copolymer; alkyl acrylate polymer; 2-
4 acrylamido-2-methylpropane sulfonic acid/acrylamide copolymers;
5 sulfonated styrene/maleic anhydride copolymers; vinylpyrrolidone/2-
6 acrylamido-2-methylpropane sulfonic acid/acrylamide terpolymers; 2-
7 acrylamido-2-methylpropane sulfonic acid/N-N-
8 dimethylacrylamide/acrylamide terpolymers; sulfonated styrene/maleic
9 anhydride copolymer; a vinyl pyrrolidone/2-acrylamido-2-methylpropane
10 sulfonic acid/acrylamide terpolymer; an 2-acrylamido-2-methylpropane
11 sulfonic acid/N-N-dimethylacrylamide/acrylamide terpolymer; and any
12 combination in any proportion of the foregoing.

1 35. The well treatment fluid according to Claim 34, wherein the alkyl acrylate
2 polymer comprises a polymer containing at least one unit selected from
3 the group consisting of dimethylaminoethyl methacrylate,
4 dimethylaminopropyl methacrylamide, quaternized dimethylaminoethyl
5 methacrylate, and any combination in any proportion of the foregoing.

1 36. The well treatment fluid according to Claim 24, wherein the organic
2 compound is selected from the group consisting of any one or more
3 polymers comprising: polymerized units having a cross-linking
4 functionality capable of crosslinking with the vinyl amine units of the
5 water-soluble polymer.

1 37. The well treatment fluid according to Claim 24 or 36, wherein the organic
2 compound is selected to have the cross-linking functionality sterically
3 hindered.

1 38. The well treatment fluid according to Claim 37, wherein the organic
2 compound is further selected from the group consisting of any one or more
3 polymers comprising: polymerized units of t-butyl acrylate and 2-
4 acrylamido-2-methylpropanesulfonic acid, and any combination in any
5 proportion of the foregoing.

1 39. The well treatment fluid according to Claim 24, wherein the organic
2 compound is further selected from the group consisting of any one or more
3 polymers comprising: polymerized units of t-butyl acrylate and 2-
4 acrylamido-2-methylpropanesulfonic acid, and any combination in any
5 proportion of the foregoing.

1 40. The well treatment fluid according to Claim 24, wherein the organic
2 compound is further selected from the group consisting of: sulfonated
3 styrene/maleic anhydride copolymer, a vinyl pyrrolidone/2-acrylamido-2-
4 methylpropanesulfonic acid copolymer/acrylamide terpolymer, an 2-
5 acrylamido-2-methylpropanesulfonic acid copolymer/N-N-
6 dimethylacrylamide/acrylamide terpolymer, and any combination in any
7 proportion of the foregoing.

1 41. The well treatment fluid according to Claim 24 or 29, wherein the gel time
2 of the well treatment fluid is less than 100 hours when measured at 190°F
3 (88°C).

1 42. The method according to Claim 1, wherein the gel time is less than 30
2 hours when measured at 190°F (88°C).

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